Simulation Campaigns In a Nutshell

- We provide simulation productions tailored to the needs of the collaboration, as defined by the DSCs and PWGs.
- Simulation campaigns are conducted monthly, based on the software release for the corresponding month (e.g., 25.04 for April 2025).
- These simulations serve as the standard for detector and physics studies for the preTDR and also the Early Science Program.

- The Production WG manages the simulation campaigns.
- In the past year, monthly simulation campaigns consumed approximately 15 million core hours on the Open Science Grid (OSG), generating over 500 TB of simulation data.
- For additional information on our productions on the OSG, please refer to Sakib's talk at CHEP 2024.

We are capable of integrating new detector geometry and algorithms within a month, processing millions of events needed to assess scientific impact.

DIS : Current Production Sets

DIS NC:

pythia8

- 18x275
  - q2>1
  - q2>10
  - q2>100
  - q2>1000
- 5x41
  - q2>1
  - q2>10
  - q2>100
- 10x100
  - q2>1
  - q2>10
  - q2>100
  - q2>1000

DIS CC:

pythia8

- 18x275
  - q2>100
  - q2>1000
- 5x41
  - q2>100
- 10x100
  - q2>100
  - q2>1000

Total number of pythia8 DIS datasets: 16

DIS-Current Production Sets

eA:

- BeAGLE1.03.02-1.0
  - eCu_ep_10x115
  - eHe3_10x166
  - eCu_en_10x115
  - eRu_en_10x115
  - eRu_ep_10x115

In total, 5 DIS eA datasets

EXCLUSIVE - Current Production Sets

DEMP:

- DEMPgen-1.2.2:
  - 10x100 (q2=3 to 10, q2=10 to 20, q2= 20 to 35) pi+
  - 18x275 (q2=3 to 10, q2=10 to 20, q2= 20 to 35) pi+
  - 5x41 (q2=3 to 10, q2=10 to 20, q2= 20 to 35) pi+
  - 5x41 (q2=1 to 10, q2=10 to 20, q2= 20 to 35) K+Lambda
- DEMPgen-1.2.3
  - 10x130 (q2=3 to 10, q2=10 to 20, q2= 20 to 35) pi+
  - 10x130 (q2=3 to 10, q2=10 to 20, q2= 20 to 35) K+Lambda

In total, 18 DEMP datasets

EXCLUSIVE - Current Production Sets

DIFFRACTIVE_JPSI_ABCONV:

- lAger3.6.1-1.0
  - 10x100
  - 5x41
  - 18x275
  - 5x100
  - 10x130

In total, 5 DIFFRACTIVE_JPSI datasets

EXCLUSIVE - Current Production Sets

DIFFRACTIVE_PHI_ABCONV:

- Sartre-1.39-1.0
  - 18x110_Au *: This is in principle reproducible from the run cards in the version controlled repo. However, currently not labelled as such in our storage because the datasets were produced before the repo was was created.
    - Coherent
      - bnonsat_eAu
      - bnonsat_eAu (q2= 1 to 15)
  - 10x100_Au
    - Coherent
      - bsat_eAu (q2=1 to 20)

In total, 3 DIFFRACTIVE PHI datasets

The datasets with asterisk were produced before we introduced version control policy and should be reviewed to ensure that they are indeed reproducible and evaluate whether they need to be kept running

EXCLUSIVE - Current Production Sets

DVMP

- EpIC-1.0.0-1.1
  - pi0 (q2=1 to 100)

Just 1 DVMP dataset

EXCLUSIVE

DVCS *: No documentation

- 10x100 (hiAcc, hiDiv)
- 5x41 (hiAcc, hiDiv)
- 18x275 (hiAcc, hiDiv)

TCS *: No documentation

- 10x100 (hiAcc, hiDiv)
- 5x41 (hiAcc, hiDiv)
- 18x275 (hiAcc, hiDiv)

EXCLUSIVE

UCHANNEL_RHO - 10x100 *

UCHANNEL_PI0 - 18x275 *

2 Datasets

New Requests

DIFFRACTIVE_JPSI

- EStarlight
  - **eSTARlight1.2.0_eCuCoherentJPsi_10x115_q2_0to10**
  - **eSTARlight1.2.0_eCuCoherentPhi_10x115_q2_0to10**
  - **eSTARlight1.2.0_eRuCoherentJPsi_10x115_q2_0to10**
  - **eSTARlight1.2.0_eRuCoherentPhi_10x115_q2_0to10**

SINGLES - Current Production Datasets

e-, e+, kaon-, kaon+, proton, neutron, pi-, pi0, pi+ : 3 to 50 deg, 45 to 135 deg, 130 to 177 deg

Gamma, mu-, e-: Scan over eta (-1.7 to 1.7)

No changes planned going forward

SIDIS- Current Production Datasets

Pythia6-eic-1.0.0:

- 5x41 (q2=0to1)
- 10x100 (q2=0to1)
- 10x275 (q2=0to1)
- 18x275 (q2=0to1)

4 very resource-intensive datasets.

SIDIS- Current Production Datasets

D0

Pythia8.306-1.0:

- 18x275 (hiAcc, hiDiv)

Lambda

Pythia8.306-1.0:

- 18x275 (hiAcc,hiDiv)

4 Datasets in total

Simulation Campaigns and Background Integration

- The 25.04 simulation campaign will include background samples for selected productions as described in the previous slides.

- It is essential for the collaboration to have a clear understanding of the various background contributions:
  - What they represent,
  - How they are generated, and
  - Which should be applied to each production.

DIS: Discussion Topics

Background Mixed Running Plan:

Signal:
Case 1: pythia8 DIS NC q2>1 (1 signal per integration frame)
Case 2: pythia6 SIDIS q2=0 to 1 (realistic signal frequency)
Case 3: No signal
+
Electron Beamgas (realistic frequency at 10000Ahr)
+
Proton Beam gas (realistic frequency at 10000Ahr)
+
Electron Synchrotron Radiation (realistic frequency)

Availability matrix

BeamGas	Files	Frequency (10000 Ahr)	Frequency (100 Ahr)	
18x275 electron	X	✓	X	
18x275 proton	✓	✓	✓	
10x100 electron	✓	✓	X	
10x100 proton	✓	✓	✓	
5x41 electron	X	X	X	
5x41 proton	X	X	X	
10x275 electron	✓	✓	X	non-standard simulation configuration
10x275 proton	✓	✓	✓	non-standard simulation configuration
SynRad	Files	Frequency		
18 GeV electron	✓	✓		
10 GeV electron	X	X		
5 GeV electron	X	X		
MinBias	Files	Frequency		
18x275	✓	✓		
10x100	✓	✓		
5x41	✓	✓		
10x275	✓	✓		non-standard simulation configuration

Which energy would be best to run first or do we run both?

1) 10x275: Caveat of using 18 GeV electron synrad. Case 2 signal frequency is 500kHz.
2) 18x275: Caveat of using 10 GeV electron beamgas. Case 2 signal frequency is 83 kHz.

Background Integration Plan

- We cannot run the background simulations ourselves due to the absence of steering files in some cases. That is limiting our ability to generate the missing files (turning the × in the previous slide into ✓).

- We will work with the Background TF to incorporate background modeling software into the ePIC software stack:
  - We aim to make background estimates available for all settings as needed.
  - We aim to ensure background estimates can be reliably reproduced. Not only the MC inputs for the signal, but also those for the background, need to comply with our **policy**.

- This will be an ongoing process.

Backgrounds - Current Production Datasets

Electron beamgas:

10 GeV

Proton beamgas:

100 GeV

275 GeV

Electron Synrad:

18 GeV

Is there any benefit to keep these running as standalone samples since they will be used in the background mixing?

Discussion Topics

- For the pre-TDR, we have established a set of standard productions that we generate regularly.
- This set continues to grow as we further develop the preTDR and Early Science Program.
- This expansion requires coordination:

Discussion Item 1
- For the Early Science Program, priorities are determined by the PWGs.
- **We need to be informed of these priorities.** Please let the ACs know who keep us posted in the regular AC/SCC meetings.

Discussion Item 2
- We have a **policy** in place for MC inputs to simulation productions, such as event generator files or background files.
- A **request form** is available to collect all necessary information.
- **We welcome feedback on this procedure to better meet simulation requirements, including replication and reproducibility.**

Discussion Item 3
- We have started to train production liaisons to assist with simulation productions.
- These liaisons understand the needs of the PWGs and support the running of relevant productions.
- The more liaisons we have, the more simulations we can conduct, and the greater the potential for automation.
- Training sessions are currently offered on **every Friday** at **1:00 pm (EDT)** via **Zoom**.
- **Who would be willing to contribute to this effort?**